WEST Search History

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DATE: Sunday, March 21, 2004

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☐	L5	L4 and (internal$3 or inner or inside or anatomy or organ or heart or brain or lung or kidney or pelvis or leg or ankle or wrist)	34
☐	L4	L3 and (image or imaging or scan$5)	62
☐	L3	L2 and (scatter$4 or backscatter$4 or "back scatter$4" or nonreflect$4 or non-reflect$4 or "non reflect$4")	91
☐	L2	L1 and ((parabolic$4 or parabola) with (reflect$4 or antenn$2))	459
☐	L1	Cassegrain	1742

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Search Results - Record(s) 1 through 34 of 34 returned.

☐ 1. Document ID: US 20030224801 A1

Using default format because multiple data bases are involved.

L5: Entry 1 of 34 File: PGPB Dec 4, 2003

PGPUB-DOCUMENT-NUMBER: 20030224801
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20030224801 A1

TITLE: High data rate wireless communication system

PUBLICATION-DATE: December 4, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Lovberg, John	San Diego	CA	US	
Chedester, Richard	Whately	MA	US	
Johnson, Paul	Kihei	HI	US	
Slaughter, Louis	Weston	MA	US	

US-CL-CURRENT: 455/454; 455/73

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWC | Draw D

☐ 2. Document ID: US 20030080907 A1

L5: Entry 2 of 34 File: PGPB May 1, 2003

PGPUB-DOCUMENT-NUMBER: 20030080907
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20030080907 A1

TITLE: Easy set-up, low profile, vehicle mounted, satellite antenna

PUBLICATION-DATE: May 1, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Wang, James June-Ming	San Marino	CA	US	
Sun, Paul K.	Greenwich	CT	US	
Santora, Russell Geoffrey	Pasadena	CA	US	

US-CL-CURRENT: 343/713; 343/757

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

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☐ 3. Document ID: US 20030080898 A1

L5: Entry 3 of 34 File: PGPB May 1, 2003

PGPUB-DOCUMENT-NUMBER: 20030080898
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20030080898 A1

TITLE: Easy set-up, low profile, vehicle mounted, in-motion tracking, satellite antenna

PUBLICATION-DATE: May 1, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Wang, James June-Ming	San Marino	CA	US	
Sun, Paul K.	Greenwich	CT	US	
Santora, Russell Geoffrey	Pasadena	CA	US	
Mahon, John P.	Thousand Oaks	CA	US	

US-CL-CURRENT: 342/359; 342/383

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

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☐ 4. Document ID: US 20030053048 A1

L5: Entry 4 of 34 File: PGPB Mar 20, 2003

PGPUB-DOCUMENT-NUMBER: 20030053048
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20030053048 A1

TITLE: Electron microscope and spectroscopy system

PUBLICATION-DATE: March 20, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Bennett, Robert	Gloucestershire		GB	
Woolfrey, Andrew Mark	Gloucestershire		GB	
Day, John Charles Clifford	Bristol		GB	
Bewick, Angus	Bristol		GB	

US-CL-CURRENT: 356/301

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

5. Document ID: US 20030021044 A1

L5: Entry 5 of 34 File: PGPB Jan 30, 2003

PGPUB-DOCUMENT-NUMBER: 20030021044
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20030021044 A1

TITLE: Precision formed membrane surface for electromagnetic radiation concentration and method of forming same

PUBLICATION-DATE: January 30, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Dragovan, Mark W.	Chicago	IL	US	

US-CL-CURRENT: 359/847; 359/838, 359/900

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

6. Document ID: US 20030016539 A1

L5: Entry 6 of 34 File: PGPB Jan 23, 2003

PGPUB-DOCUMENT-NUMBER: 20030016539
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20030016539 A1

TITLE: High efficiency non-imaging optics

PUBLICATION-DATE: January 23, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Minano, Juan C.	Madrid	CA	ES	
Benitez, Pablo	Madrid	TN	ES	
Gonzalez, Juan C.	Madrid		ES	
Falicoff, Waqidi	Solana Beach		US	
Caulfield, H. J.	Cornersville		US	

US-CL-CURRENT: 362/347; 362/348

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

7. Document ID: US 20020182716 A1

L5: Entry 7 of 34 File: PGPB Dec 5, 2002

PGPUB-DOCUMENT-NUMBER: 20020182716
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020182716 A1

TITLE: Support for chromophoric elements

PUBLICATION-DATE: December 5, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Weisbuch, Claude	Paris		FR	
Benisty, Henri	Palaiseau		FR	

US-CL-CURRENT: 435/287.2; 313/483

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

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☐ 8. Document ID: US 20020176139 A1

L5: Entry 8 of 34 File: PGPB Nov 28, 2002

PGPUB-DOCUMENT-NUMBER: 20020176139
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020176139 A1

TITLE: SONET capable millimeter wave communication system

PUBLICATION-DATE: November 28, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Slaughter, Louis	Weston	MA	US	
Olsen, Randall	Carlsbad	CA	US	
Phillips, Chester	Germantown	MD	US	
Johnson, Paul	Kihei	HI	US	
Lovberg, John	San Diego	CA	US	
Tang, Kenneth Y.	Alpine	CA	US	
Houghton, George	San Diego	CA	US	
Kolinko, Vladimir	San Diego	CA	US	
Mooney, Ryan	Kihei	HI	US	

US-CL-CURRENT: 398/121; 370/328, 370/338

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw De

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☐ 9. Document ID: US 20020165002 A1

L5: Entry 9 of 34 File: PGPB Nov 7, 2002

PGPUB-DOCUMENT-NUMBER: 20020165002

PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020165002 A1

TITLE: Millimeter wave transceivers for high data rate wireless communication links

PUBLICATION-DATE: November 7, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Kolinko, Vladimir	San Diego	CA	US	
Chedester, Richard	Whately	MA	US	
Olsen, Randall B.	Carlsbad	CA	US	
Lovberg, John	San Diego	CA	US	
Tang, Kenneth Y.	Alpine	CA	US	

US-CL-CURRENT: 455/500; 455/73

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw D

☐ 10. Document ID: US 20020164958 A1

L5: Entry 10 of 34 File: PGPB Nov 7, 2002

PGPUB-DOCUMENT-NUMBER: 20020164958
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020164958 A1

TITLE: Millimeter wave and copper pair communication link

PUBLICATION-DATE: November 7, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Slaughter, Louis	Weston	MA	US	
Lambert, Thomas	Makawao	HI	US	
Nguyen, Huan	Annanandale	VA	US	
Olsen, Randall	Carlsbad	CA	US	
Lovberg, John	San Diego	CA	US	
Tang, Kenneth Y.	Alpine	CA	US	
Kolinko, Vladimir			US	

US-CL-CURRENT: 455/73; 455/8

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw D

☐ 11. Document ID: US 20020164951 A1

L5: Entry 11 of 34 File: PGPB Nov 7, 2002

PGPUB-DOCUMENT-NUMBER: 20020164951
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20020164951 A1

TITLE: Millimeter wave and ethernet communication system

PUBLICATION-DATE: November 7, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Slaughter, Louis	Weston	MA	US	
Hill, Jon	Socorro	NM	US	
Lambert, Thomas	Makawao	HI	US	
Nguyen, Huan	Annandale	VA	US	
Olsen, Randall	Carlsbad	CA	US	
Lovberg, John	San Diego	CA	US	
Tang, Kenneth Y.	Alpine	CA	US	
Kolinko, Vladimir	San Diego	CA	US	

US-CL-CURRENT: 455/39; 455/25

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw D

☐ 12. Document ID: US 6665546 B2

L5: Entry 12 of 34 File: USPT Dec 16, 2003

US-PAT-NO: 6665546
DOCUMENT-IDENTIFIER: US 6665546 B2

TITLE: High speed, point-to-point, millimeter wave dated communication system

DATE-ISSUED: December 16, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Slaughter; Louis	Weston	MA		
Hill; Jon	Socorro	NM		
Lambert; Thomas	Makawao	HI		
Nguyen; Huan	Annandale	VA		
Olsen; Randall	Carlsbad	CA		
Lovberg; John	San Diego	CA		
Tang; Kenneth Y.	Alpine	CA		
Kolinko; Vladimir	San Diego	CA		

US-CL-CURRENT: 455/562.1; 370/310, 455/10, 455/25, 455/505, 455/67.15

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw D

☐ 13. Document ID: US 6639733 B2

L5: Entry 13 of 34 File: USPT Oct 28, 2003

US-PAT-NO: 6639733
DOCUMENT-IDENTIFIER: US 6639733 B2

TITLE: High efficiency non-imaging optics

DATE-ISSUED: October 28, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Minano; Juan C.	Madrid			ES
Benitez; Pablo	Madrid			ES
Gonzalez; Juan C.	Madrid			ES
Falicoff; Waqidi	Solana Beach	CA		
Caulfield; H. J.	Cornersville	TN		

US-CL-CURRENT: 359/728; 359/718, 359/726, 362/327

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw De

☐ 14. Document ID: US 6567678 B1

L5: Entry 14 of 34 File: USPT May 20, 2003

US-PAT-NO: 6567678
DOCUMENT-IDENTIFIER: US 6567678 B1

TITLE: Multiplex sensor and method of use

DATE-ISSUED: May 20, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Oosta; Gary M.	Gurnee	IL		
Jeng; Tayy-Wen	Vernon Hills	IL		
Lindberg; John M.	Grayslake	IL		
McGlashen; Michael L.	Grayslake	IL		
Pezzaniti; Joseph L.	Round Lake	IL		

US-CL-CURRENT: 600/316; 356/364, 600/310

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw De

☐ 15. Document ID: US 6545645 B1

L5: Entry 15 of 34 File: USPT Apr 8, 2003

US-PAT-NO: 6545645
DOCUMENT-IDENTIFIER: US 6545645 B1

TITLE: Compact frequency selective reflective antenna

DATE-ISSUED: April 8, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Wu; Te-Kao	Rancho Palos Verdes	CA		

US-CL-CURRENT: 343/781P; 343/781CA

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw Des

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☐ 16. Document ID: US 6502944 B1

L5: Entry 16 of 34 File: USPT Jan 7, 2003

US-PAT-NO: 6502944
DOCUMENT-IDENTIFIER: US 6502944 B1

TITLE: Precision formed membrane surface for electromagnetic radiation concentration and method of forming same

DATE-ISSUED: January 7, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Dragovan; Mark W.	Chicago	IL	60615	

US-CL-CURRENT: 359/847; 359/851, 359/857, 359/868

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw Des

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☐ 17. Document ID: US 6449103 B1

L5: Entry 17 of 34 File: USPT Sep 10, 2002

US-PAT-NO: 6449103
DOCUMENT-IDENTIFIER: US 6449103 B1

TITLE: Solid catadioptric omnidirectional optical system having central coverage means which is associated with a camera, projector, medical instrument, or similar article

DATE-ISSUED: September 10, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Charles; Jeffrey R.	Pasadena	CA	91104	

US-CL-CURRENT: 359/725; 359/366, 359/729, 359/859

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw De

☐ 18. Document ID: US 6333826 B1

L5: Entry 18 of 34 File: USPT Dec 25, 2001

US-PAT-NO: 6333826
DOCUMENT-IDENTIFIER: US 6333826 B1

TITLE: Omniramic optical system having central coverage means which is associated with a camera, projector, or similar article

DATE-ISSUED: December 25, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Charles; Jeffrey R.	Pasadena	CA	91104	

US-CL-CURRENT: 359/725; 359/728, 359/729, 359/731

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw De

☐ 19. Document ID: US 6070093 A

L5: Entry 19 of 34 File: USPT May 30, 2000

US-PAT-NO: 6070093
DOCUMENT-IDENTIFIER: US 6070093 A
** See image for Certificate of Correction **

TITLE: Multiplex sensor and method of use

DATE-ISSUED: May 30, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Oosta; Gary M.	Gurnee	IL		
Jeng; Tayy-Wen	Vernon Hills	IL		
Lindberg; John M.	Grayslake	IL		
McGlashen; Michael L.	Grayslake	IL		
Pezzaniti; Joseph L.	Round Lake	IL		

US-CL-CURRENT: 600/316; 356/39, 600/310, 600/322

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw De

☐ 20. Document ID: US 6054947 A

L5: Entry 20 of 34 File: USPT Apr 25, 2000

US-PAT-NO: 6054947
DOCUMENT-IDENTIFIER: US 6054947 A

TITLE: Helicopter rotorblade radar system

DATE-ISSUED: April 25, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Kosowsky; Lester H.	Stamford	CT	06905	

US-CL-CURRENT: 342/191; 342/192, 342/25A, 342/25F, 342/25

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw De

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☐ 21. Document ID: US 5578140 A

L5: Entry 21 of 34 File: USPT Nov 26, 1996

US-PAT-NO: 5578140
DOCUMENT-IDENTIFIER: US 5578140 A

TITLE: Solar energy plant

DATE-ISSUED: November 26, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Yogev; Amnon	Rehovot			IL
Krupkin; Vladimir	Rishon LeZion			IL
Epstein; Michael	Rishon LeZion			IL

US-CL-CURRENT: 136/246; 126/572, 126/600, 126/685, 126/686, 136/248, 422/186, 60/641.5

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw De

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☐ 22. Document ID: US 5227797 A

L5: Entry 22 of 34 File: USPT Jul 13, 1993

US-PAT-NO: 5227797
DOCUMENT-IDENTIFIER: US 5227797 A

TITLE: Radar tomography

DATE-ISSUED: July 13, 1993

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Murphy; Quentin M.	Bronxville	NY	10708	

US-CL-CURRENT: 342/22; 600/425

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw De

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☐ 23. Document ID: US 4843242 A

L5: Entry 23 of 34 File: USPT Jun 27, 1989

US-PAT-NO: 4843242
DOCUMENT-IDENTIFIER: US 4843242 A
**** See image for Certificate of Correction ****

TITLE: Infrared microscope employing a projected field stop

DATE-ISSUED: June 27, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Doyle; Walter M.	Laguna Beach	CA		

US-CL-CURRENT: 250/330; 250/338.1, 250/341.8, 359/389

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw De

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☐ 24. Document ID: US 4797685 A

L5: Entry 24 of 34 File: USPT Jan 10, 1989

US-PAT-NO: 4797685
DOCUMENT-IDENTIFIER: US 4797685 A

TITLE: Offset shaped antenna reflector

DATE-ISSUED: January 10, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Guler; Michael G.	Melbourne	FL		
Patel; Sharadchandra D.	Melbourne	FL		
Conn; James K.	Indialantic	FL		
Foster; Marcus L.	Palm Bay	FL		

US-CL-CURRENT: 343/912; 29/600, 343/840

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw De

25. Document ID: US 4688325 A

L5: Entry 25 of 34 File: USPT Aug 25, 1987

US-PAT-NO: 4688325
DOCUMENT-IDENTIFIER: US 4688325 A

TITLE: Technique for fabricating offset, shaped antenna reflectors

DATE-ISSUED: August 25, 1987

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Guler; Michael G.	Melbourne	FL		
Patel; Sharadchandra D.	Melbourne	FL		
Conn; James K.	Indialantic	FL		
Foster; Marcus L.	Palm Bay	FL		

US-CL-CURRENT: 29/600

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw De

26. Document ID: US 4655592 A

L5: Entry 26 of 34 File: USPT Apr 7, 1987

US-PAT-NO: 4655592
DOCUMENT-IDENTIFIER: US 4655592 A

TITLE: Particle detection method and apparatus

DATE-ISSUED: April 7, 1987

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Allemand; Charly D.	Newtonville	MA		

US-CL-CURRENT: 356/237.3; 219/121.74, 250/222.2, 250/559.16, 250/559.41, 356/338, 359/859, 362/297

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw De

27. Document ID: US 4595833 A

L5: Entry 27 of 34 File: USPT Jun 17, 1986

US-PAT-NO: 4595833
DOCUMENT-IDENTIFIER: US 4595833 A
** See image for Certificate of Correction **

TITLE: Multiple internal reflection cell optical system for use in infrared spectrophotometry of liquid and fluidized samples

DATE-ISSUED: June 17, 1986

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Sting; Donald W.	New Canaan	CT	06840	

US-CL-CURRENT: 250/353; 250/252.1, 250/338.1, 250/339.06, 250/339.11, 356/300, 359/859

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw De

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☐ 28. Document ID: US 4404468 A

L5: Entry 28 of 34 File: USPT Sep 13, 1983

US-PAT-NO: 4404468
DOCUMENT-IDENTIFIER: US 4404468 A

TITLE: Pyrodetector

DATE-ISSUED: September 13, 1983

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Kleinschmidt; Peter	Munich			DE

US-CL-CURRENT: 250/342; 250/338.3, 250/347, 250/349, 250/DIG.1

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw De

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☐ 29. Document ID: US 4126866 A

L5: Entry 29 of 34 File: USPT Nov 21, 1978

US-PAT-NO: 4126866
DOCUMENT-IDENTIFIER: US 4126866 A

TITLE: Space filter surface

DATE-ISSUED: November 21, 1978

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pelton; Edward L.	Columbus	OH		

US-CL-CURRENT: 343/909; 343/872

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw De

☐ 30. Document ID: US 4106023 A

L5: Entry 30 of 34 File: USPT Aug 8, 1978

US-PAT-NO: 4106023
DOCUMENT-IDENTIFIER: US 4106023 A

TITLE: Navigation aid system

DATE-ISSUED: August 8, 1978

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Baghdady; Elie J.	Weston	MA	02193	

US-CL-CURRENT: 342/405

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw De

☐ 31. Document ID: US 3968362 A

L5: Entry 31 of 34 File: USPT Jul 6, 1976

US-PAT-NO: 3968362
DOCUMENT-IDENTIFIER: US 3968362 A

TITLE: Optical system for laser doppler homodyne detection

DATE-ISSUED: July 6, 1976

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Mocker; Hans W.	Minneapolis	MN		

US-CL-CURRENT: 250/216; 356/5.09

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw De

☐ 32. Document ID: US 3852765 A

L5: Entry 32 of 34 File: USPT Dec 3, 1974

US-PAT-NO: 3852765
DOCUMENT-IDENTIFIER: US 3852765 A

TITLE: SPHERICAL DOUBLE REFLECTOR ANTENNA

DATE-ISSUED: December 3, 1974

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bresler; Aaron D.	Merrick	NY		
Stein; Emanuel	Fair Lawn	NJ		
Erdmann; M. Otto	Denville	NJ		

US-CL-CURRENT: 343/781R; 343/837, 343/912

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw De

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☐ 33. Document ID: US 3822098 A

L5: Entry 33 of 34 File: USPT Jul 2, 1974

US-PAT-NO: 3822098
DOCUMENT-IDENTIFIER: US 3822098 A
**** See image for Certificate of Correction ****

TITLE: MULTISPECTRAL SENSOR MEANS MEASURING DEPOLARIZED RADIATION

DATE-ISSUED: July 2, 1974

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Rudder; Charles L.	Granite City	MO		
Leader; John C.	Manchester	MO		
Owsley; David P.	Florissant	MO		
Dalton; William A. J.	Florissant	MO		

US-CL-CURRENT: 356/320; 250/339.11, 250/347, 356/364, 356/407, 356/448

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw De

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☐ 34. Document ID: US 3814504 A

L5: Entry 34 of 34 File: USPT Jun 4, 1974

US-PAT-NO: 3814504
DOCUMENT-IDENTIFIER: US 3814504 A
**** See image for Certificate of Correction ****

TITLE: REFLECTING LENS ARRAY

DATE-ISSUED: June 4, 1974

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Brady; John Francis	Clifton	NJ		

Grill; William Augustus Lake Parsippany NJ

US-CL-CURRENT: 359/627; 359/727

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw De

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Term	Documents
INNER	3008923
INNERS	623
INSIDE	2397817
INSIDES	20991
ANATOMY	21604
ANATOMIES	640
ANATOMYS	0
ORGAN	101417
ORGANS	94467
HEART	162688
HEARTS	9109
(L4 AND (INTERNAL$3 OR INNER OR INSIDE OR ANATOMY OR ORGAN OR HEART OR BRAIN OR LUNG OR KIDNEY OR PELVIS OR LEG OR ANKLE OR WRIST)).PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD.	34

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L5: Entry 19 of 34 File: USPT May 30, 2000

DOCUMENT-IDENTIFIER: US 6070093 A
** See image for Certificate of Correction **
TITLE: Multiplex sensor and method of use

Abstract Text (3):
(b) scattering

Brief Summary Text (16):
"Noninvasive" (NI) glucose sensing techniques measure in-vivo glucose concentrations without collecting a blood sample. As defined herein, a "noninvasive" apparatus or method is one which can be used without removing a sample from, or without inserting any instrumentation into, the tissues. The concept involves irradiating a vascular region of the body with electromagnetic radiation and measuring the spectral information that results from one of four primary processes: reflection, absorption, scattering, or emission. The extent to which each of these processes occurs is dependent upon a variety of factors, including the wavelength and polarization state of the incident radiation and the glucose concentration in the body part. Glucose concentrations are determined from the spectral information by comparing the measured spectra to a calibration curve or by reference to a physical model of the tissue under examination. A brief description of noninvasive glucose measurements in the prior art is provided below.

Brief Summary Text (24):
U.S. Pat. Nos. 5,362,966, 5,237,178, 5,533,509, 4,655,225. The principles of operation are similar to those described for the NIR, except that the penetration depth of the MIR light is less than that for NIR. As a consequence, most measurements in this region have been performed using a backscattering geometry. As defined herein, a "backscattering geometry" describes a configuration wherein scattered radiation is collected on the same side of the sample as the entry point of the incident radiation. A "transmission geometry" describes a configuration wherein light is transmitted through the sample and collected on the opposite side of the sample as the entry point of the incident radiation.

Brief Summary Text (31):
Scattering

Brief Summary Text (32):
As defined herein "scattering" includes Rayleigh, Mie, and Raman scattering. Glucose decreases the intensity of Mie scattering by decreasing the refractive index difference between the extracellular fluid (ECF) and cell membranes. Gratton et al. (U.S. Pat. No. 5,497,769) have proposed a sensor based upon this effect; however, the signal to noise ratio for this technique is expected to be inadequate for glucose measurement.

Brief Summary Text (33):
Raman scattering

Brief Summary Text (34):
U.S. Pat. No. 5,553,616 teaches the use of Raman scattering with excitation in the

near infrared (780 nm) and an artificial neural network for measuring blood glucose. Glucose Raman bands that are distinct from protein Raman bands may be chosen, however, the sensitivity of this method limits its applicability for in-vivo measurements. WO 92/10131 discusses the application of stimulated Raman spectroscopy for detecting the presence of glucose.

Brief Summary Text (51):
A change in temperature can have a nonlinear effect on the infrared spectrum by altering the intensities as well as the frequencies of the dominant water absorption bands. A temperature change will also modify the refractive index of the sample which, in turn, will alter the scattering properties of the sample. The effective optical path length will change as a result of the aforementioned change in scattering properties. Thus, physiological and spectral parameters are often inseparably linked and a change in one of these variables can modulate the impact of other interfering variables. The result is a nonlinear change in the measured signal for a linear change in one of the physiological or spectral variables.

Brief Summary Text (57):
On a longer time scale, the physical properties of human skin change as a normal function of aging. These changes include decreased solubility (Schnider, S. L., and Kohn, R. R., J. Clin. Invest. 67, (1981) pp.1630-1635), decreased proteolytic digestibility (Hamlin, C. R., Luschin, J. H., and Kohn, R. R., Exp. Gerontol. 13, (1978) pp. 415-523), increased heat denaturation time (Snowden, J. M., Eyre, D. R., and Swann, D. H., Biochem. Biophys. Acta, 706, (1982) pp. 153-157), and the accumulation of yellow and fluorescent materials (LaBella, F. S., and Paul, G., J. Gerontol., 20, (1964) pp. 54-59). These changes appear to be accelerated in diabetes, and may alter the scattering properties of the skin via the formation of intermolecular crosslinks between collagen fibrils.

Brief Summary Text (72):
As will be described more fully below, the present invention measures the reflected, scattered, absorbed, emitted, or transmitted light as a function of multiple dimensions. As defined herein, a "dimension" is a measured quantity. It can be related to light which is reflected, scattered, absorbed, emitted, or transmitted by the sample. It can also be related to time or space or both.

Brief Summary Text (80):
(b) scattering

Brief Summary Text (87):
(b) scattering

Brief Summary Text (94):
(b) scattering

Brief Summary Text (101):
(b) scattering

Brief Summary Text (106):
Another embodiment of the present invention provides enhanced selectivity by illuminating the sample with electromagnetic radiation and recording the intensity of the reflected, absorbed, scattered, emitted or transmitted radiation as a function of at least three dimensions wherein the at least three dimensions are selected from the group consisting of:

Brief Summary Text (113):
(b) scattering

Brief Summary Text (119):
(b) scattering

Brief Summary Paragraph Table (1):

TABLE 1

Char. Frequ. (Hz).sup.a	Vis. Raman.sup.b	NIR Raman.sup.b	Fluorescence.sup.b	NIR.sup.b	MIR.sup.b	Polarization.sup.b	Photoacoustics.sup.b	Subject
Temperature	0.1-1	6	6	5	2	2	3	2
pH	0.01	3	3	5	3	3	5	5
Tissue Scattering	10-100	1	3	5	3	3	8	8
Pulsatile flow	1	5	5	5	7	4	8	8
Body part movement	1-10	2	4	4	1	1	3	3
Electrolyte Concentrations	0.1-1	3	3	5	3	3	8	4
Pressure at the interface	.1-10	6	6	3	3	3	5	3
Refractive Index	0.1-10	5	4	3	3	3	5	3

Legend .sup.a Numerals in this column indicate the oscillation frequencies (Hz) of several important physiological variables. .sup.b Numerals in this column indicate the relative sensitivity (1-10, 1 being most sensitive) of the spectroscopic measurement to several important physiological variables.

Drawing Description Text (6):
FIGS. 5(a)-5(c) are is a depiction of the scattered light intensity predicted for a sample which interacts with the light produced by the polarization modulator of FIG. 4, wherein the sample behaves as: 5(a) a linear polarizer oriented at 45.degree., 5(b) a linear polarizer oriented at 0.degree., and 5(c) a circular polarizer.

Detailed Description Text (4):
When electromagnetic radiation impinges on a sample, the radiation is reflected, scattered, absorbed, emitted, or transmitted. The extent to which any of these processes occurs depends upon the chemical constitution of the sample as well as the frequency (or wavelength), polarization state, and angle of incidence of the impinging light beam. The methods of the prior art employ only a small fraction of the available spectroscopic information for measurement purposes. As a result, they are unable to accurately measure glucose in the presence of dominating contributions from physiological and spectral interferences.

Detailed Description Text (14):
##EQU2## (b) Secondly, the photoacoustic response is a function of the optical energy absorbed (as opposed to transmitted). Thus, scattering effects are much less important for PAS measurements than for optical absorbance measurements.

Detailed Description Text (16):
Scattering

Detailed Description Text (17):
An electromagnetic wave incident on an isolated molecule with an electron cloud will cause the electrons to oscillate about their equilibrium positions, in synchrony with the applied wave. The resulting electronic oscillator emits radiation (scatters) in all directions in a plane perpendicular to the oscillating electrons. Some molecules are more susceptible to applied electromagnetic waves than others, an d the tendency of their electrons to oscillate is defined by a parameter, a, called the polarizability.

Detailed Description Text (18):
Refraction is the result of radiation scattered in the same direction as that of the incident light wave. The phase of the scattered wave is different from that of the wave that passes through the sample. These two types of waves then recombine (interfere) to produce a wave that has apparently passed through the sample with a different velocity. The parameter used to describe this phenomenon is called the refractive index (n) defined as:

Detailed Description Text (20):
The refractive index, and therefore the scattering, is dependent on frequency.

Frequency-dependent refraction is known as dispersion, the phenomenon that gives rise to the familiar splitting of white light into colors by a prism. The frequency dependence of scattering, and therefore n, depends on .alpha., the wavelength (.lambda.), the polarization state, and the number and size of the scatterers. For particles that are small with respect to the wavelength (Rayleigh scattering), scattering scales as 1/.lambda..sup.4. For tissue samples where the size of the scatterers (cells) is near the wavelength of light (Mie scattering), the scattering intensity scales approximately as 1/.lambda..sup.3/2.

Detailed Description Text (21):
In tissues, light scattering occurs because of a mismatch between the index of refraction of the ECF and the cells and organelles comprising the tissue. The index of refraction of the ECF varies as its composition changes, whereas the index of the cellular membranes and organelles remains relatively constant.

Detailed Description Text (22):
A change in the glucose concentration in tissues can alter the intensity and directionality of scattering; however, a direct measurement of glucose via scattering is difficult because:

Detailed Description Text (23):
(a) the change in scattering produced by a physiologically relevant change in glucose concentration is extremely weak,

Detailed Description Text (24):
(b) a change in glucose concentration can initiate a complex interplay of hormonally-regulated metabolic reactions in the intra- and extracellular fluid, the products of which reactions may also alter scattering intensity, and

Detailed Description Text (25):
(c) a change in glucose concentration may also alter the size of the cells (and thus their scattering properties) via a change in osmolarity of the ECF.

Detailed Description Text (26):
Raman Scattering

Detailed Description Text (27):
When light impinges on a sample, most of the scattered photons are elastically (or Rayleigh) scattered, meaning that they have the same frequency as the incident radiation. A small fraction of the scattered light (approximately one in a thousand incident photons) is inelastically scattered at frequencies that are shifted by frequencies defined by molecular vibrations. Raman scattering occurs at frequencies corresponding to the incident frequency plus or minus a molecular vibrational frequency as shown below:

Detailed Description Text (28):
where .nu..sub.Raman is the Raman scattered frequency, .nu..sub.o is the incident (laser) frequency and v.sub.vib is a vibrational frequency of the molecule under study. Raman bands having frequencies that are lower than the incident frequency are called "Stokes" shifted bands. Those with frequencies that are higher than the incident frequency are called "Anti-Stokes" bands. Stokes and Anti-Stokes shifted Raman bands are displaced symmetrically about the incident frequency. A Raman spectrum is thus a vibrational spectrum that is obtained by recording the intensity of scattered light as a function of frequency.

Detailed Description Text (29):
Because the selection rules for Raman scattering are different from those of MIR or NIR, Raman scattering is complementary to these other techniques. In other words, vibrational modes that produce intense Raman bands may be invisible in the MIR or NIR spectra. Additionally, some IR and NIR vibrational bands may not be present in

the Raman spectrum. Raman spectroscopy has a distinct advantage when compared with infrared measurements in that Raman spectroscopy can be performed easily in water. Further, glucose Raman bands that are distinct from protein Raman bands can be chosen. Unfortunately, the intensity of a "normal" Raman spectrum is usually weak.

Detailed Description Text (30):
If the laser excitation frequency lies within an electronic absorption band of a chromophore in the molecule, then some vibrations associated within that chromophore can be dramatically enhanced. This technique, known as Resonance Raman scattering, can be used to increase the sensitivity of the measurement. For example, NIR excitation into the heme absorption bands will cause an enhancement of the heme vibrational modes, far above the intensity of the protein Raman bands. Normal and Resonance Raman spectroscopies may thus yield vibrational information that is complementary to that obtained by IR or NIR methods.

Detailed Description Text (33):
Chiral molecules, such as glucose, are molecules that cannot be superimposed on their mirror image. A unique property of chiral molecules is that they are optically active, i.e., they have different refractive indexes for Left- and Right-circularly polarized light. Their differential interaction with Left- and Right-circularly polarized light is measured by means of a technique called polarimetry. Polarimetry is a method of measuring and describing changes in the polarization state of light upon interaction with a polarization element (e.g. a sample). The polarization properties of a polarization element can be divided into three groups: (1) diattenuation, (2) retardance, and (3) depolarization (see, for example, J. L. Pezzaniti, Mueller Matrix Imaging Polarimetry, Dissertation, 1993).

Detailed Description Text (35):
There are subtle, but important differences between diattenuation and dichroism. Diattenuation is measured as the difference in scattered intensity between two orthogonal polarization states. The orthogonal polarization states might be Left-circularly polarized versus Right-circularly polarized states (for a circular diattenuator) or Vertical-polarized versus Horizontally-polarized states (for a linear diattenuator). In diattenuation, the scattered intensity is modulated by both absorption and scattering processes. This contrasts with dichroism, which measures the difference in the amount of light absorbed by two orthogonal polarization states.

Detailed Description Text (36):
For turbid samples, e.g. biological samples, scattering effects are important and diattenuation measurements are performed. For weakly scattering samples, diattenuation typically reduces to the simpler circular dichroism measurement.

Detailed Description Text (40):
Depolarization is a process in which completely polarized light is coupled to unpolarized light and is defined as ##EQU4## In turbid media, an incident polarized light beam undergoes multiple scattering events. The polarization of the incident beam is degraded with each scattering event, and the depolarization can be used as a measure of the number of scattering events in the medium. Because glucose influences the overall refractive index in tissue, the number of scattering interactions changes with varying glucose concentrations, because scatter is a strong function of refractive index. As the number of scattering interactions increases, the polarized light becomes increasingly depolarized. Thus as glucose concentration changes, the scatter distribution changes and the depolarization can be monitored as an indirect measurement of scatter and glucose concentration.

Detailed Description Text (54):
All of the fluorescence parameters described above may be used to measure analyte properties (such as concentration or dynamics), however, all of these methods suffer from absorption and scattering interferences in the sample. Absorption

and/or scattering by the sample will produce a misleading result that underestimates the intensity of fluorescence emission. Scattering processes will randomize the polarization states of the emitted light. In the present invention, absorption and/or scattering measurements are used to correct the fluorescence measurements and provide a more accurate reading of .lambda..sub.max, fluorescence lifetime, quantum yield, and fluorescence polarization.

Detailed Description Text (57):
Corrections for tissue scattering

Detailed Description Text (58):
Light scattering depends on the wavelength and the polarization state of the incident light as well as the difference in refractive index between the scattering center(s) and the surrounding medium. For tissue samples, light scattering arises from the refractive index mismatch between cell or mitochondrial membranes, collagen fibers or other organelles, and the exctracellular fluid (ECF) of the tissue . As used herein, tissue scattering is taken to mean light that is scattered by tissues. Tissue scattering can change over temporal or spatial dimensions due to a variety of factors, such as the water distribution or collagen content in the tissues, diet, or disease states, such as diabetes or hypertension. For example, an increase of water in the tissue ECF will decrease the index of refraction, thereby increasing the difference in refractive index between the ECF and the cell membranes, thereby increasing tissue scattering. Tissue scattering can vary considerably between individuals due to changes in skin properties, disease states, diet or even exercise.

Detailed Description Text (59):
Tissue scattering can lead to spurious or nonlinear results for spectroscopic measurements for a variety of reasons. First, scattering results in a loss of transmitted intensity due to scattering at angles that are outside the numerical aperture of the collection optics. For an absorbance measurement, the effect is a misleading reading that overestimates the amount of light absorbed. Secondly, multiple scatter events within the tissue lead to an ill-defined optical path length. Photon trajectories through the tissue are not rectilinear as they are in homogenous media. Multiple reflections and refractions effectively increase the optical path length.

Detailed Description Text (60):
The polarization measurements described above can be used to compensate for (normalize) the effects of scattering on spectroscopic measurements. Diattenuation, retardance, and depolarization measurements provide a complete description of the polarization properties, and therefore the refractive index, of the sample. In particular, depolarization may be used as a measure of person-to-person or day-to-day variation in scattering. Multiple wavelengths may be used to enhance selectivity.

Detailed Description Text (61):
Absorbance measurements that are sensitive to scattering or optical path length can be corrected by using known relationships between the refractive index and the scattering properties of the medium. For example, the empirical relationship between wavelength and scatter intensity may be used to estimate the extent of scatter at wavelengths where direct measurement of scatter are difficult. For example, polarimetric measurements described above can be performed in the visible region or NIR region and used to normalize the measurements made at other wavelengths, e.g. measurements in MIR region.

Detailed Description Text (65):
The temperature dependence of the MIR water spectrum complicates glucose measurements by providing a variable background signal that must be subtracted in order to reveal the glucose information. Raman scattering can be an accurate

measure of temperature. The ratio of the intensities of corresponding Stokes and Anti-Stokes bands can be used to measure the temperature of a sample.

Detailed Description Text (66):
Spatial dimensions may also be used to sort out the contributions from pH, electrolytes, and temperature. A temperature gradient exists between the outer surface of the skin and the tissue inside. Accordingly, the effects of temperature on the measured signal should scale with the distance into the tissue (normal to the tissue surface) whereas contributions from electrolyte concentrations and pH should be more evenly distributed. Thus, in the foregoing example, a spatial dimension is used to separate out the effects of temperature on the measured signal from those effects due to pH and electrolyte concentrations.

Detailed Description Text (72):
For noninvasive measurements of in-vivo parameters, the incident radiation must pass through the stratum corneum before reaching viable tissues, and hence the thickness, composition, and morphology of the stratum corneum can affect measurements (see FIG. 2). As the beam penetrates into the tissue, the radiation may be scattered, absorbed, reflected or emitted by structures and chromophores that can vary dynamically and between individuals. As a result, the beam intensity decreases rapidly as it penetrates into the tissue and the majority of the spectroscopic signal arises near the surface of the tissue where the light intensity is at a maximum. As defined herein, the penetration depth, d, is the distance within the tissue at which the incident light intensity (I.sub.o) falls to (I.sub.o /e).

Detailed Description Text (73):
The scattering, absorption, and emission properties vary with the wavelength and the polarization state of the incident light. Light of different wavelengths may reach vastly different penetration depths within the tissue, and essentially all noninvasive measurements are dependent on wavelength and polarization. This effect can be used to advantage, since a judicious choice of wavelength and polarization state can provide a level of control over the depth to which the tissue will be probed by the radiation. This control can be used to selectively extract information related to particular chromophores, based on their predictable, or measurable, spatial locations within the sample.

Detailed Description Text (76):
Spatial dimensions that are generally parallel to the skin surface can also be used to provide additional selectivity. Spectroscopic images of biological tissues generally contain regular repeating structures. Image analysis techniques (such as multidimensional Fourier transformation, segmentation, or some other image processing technique) can be used to extract signals contained in certain locations or spatial frequencies in the image.

Detailed Description Text (77):
For example, a spectroscopic image of a tissue sample may reveal blood vessels of regular sizes and separation distances. Such structures will contribute particular spatial frequencies to the image. Selective spectroscopic information may be obtained from these structures by collecting a spectroscopic image (i.e. recording a spectroscopic variable as a function of two spatial variables) and performing a multidimensional Fourier transform on the spectroscopic image. The signals resulting from the blood vessels would then be selectively obtained by measuring the spectroscopic signal intensity as a function of spatial frequency. An additional advantage of the foregoing method is that the measured signal is relatively insensitive to changes in alignment or sample positioning.

Detailed Description Text (82):
The filtered light is focused onto a body part, e.g. a finger 117, by a focusing means comprising, for example, lenses 103 and 104. While a finger has been used in

the present example, it should be understood that other body parts, such as the earlobe, may be preferred, depending upon the measurement to be made and the physical characteristics of the body part. Lenses 102, 103, and 104 are, preferably, achromatic over the wavelength ranges used for the measurement. It should be understood that alternative means for providing focused light may be substituted for lenses 102, 103, and 104. Such focusing means might comprise, for example, reflective optics such as a parabolic mirror, a Cassegrain mirror, or the like. Reflective optics have the advantage of being less susceptible to chromatic aberrations, particularly in the infrared region.

Detailed Description Text (83):
Lenses 102, 103, and 104 may be held in a fixed position or, alternatively, may be moved in order to alter the focal point within the tissue or at the tissue surface. Such an altered focal point might comprise, for example, a focal point that is translated along an axis normal to the skin surface or in a direction parallel to the skin surface. For example, such a moving focal point of light might be used to make measurements as a function of the spatial position of the focused light beam. Alternatively, a defocused beam of light may be used to minimize the power density at the tissue surface or for imaging applications where it is desirable to distribute light evenly across the tissue sample.

Detailed Description Text (93):
Normalization of the acoustic signal may be accomplished by a number of alternative means. For example, the measured photoacoustic signal may be normalized to the intensity of the light emitted by light source 115. Alternatively, a measurement of the scattered intensity may be made at detector 122 (as described below).

Detailed Description Text (96):
Referring again to FIG. 3, the light exiting the polarization modulator is reflected from a patterned mirror 113 and focused onto the finger. The purpose of this beam is to measure the depolarization and diattenuation of the finger (or other body part, such as an earlobe). Measurements of the intensity of the scattered light are made by the detectors 160, 161, and 162, which are placed close to or, preferably, in contact with the finger 117. A circular polarizer is placed immediately before the active area of each detector. The circular polarizer transmits right-circular polarized light and blocks left-circular polarized light. As defined herein, close to the skin means within about 0 to 10 mm from the surface of the skin, preferably from about 0 to 1 mm from the surface of the skin or, most preferably, in contact with the skin. The placement of detectors 160, 161, and 162 close to or, preferably, in contact with the skin provides several advantages including:

Detailed Description Text (97):
(1) the capability of resolving small angular and spatial distributions of the scattered light,

Detailed Description Text (100):
As shown in FIG. 3, three detectors 160, 161, and 162 are used to detect the backscattered radiation; however, it is to be understood that a different number of detectors can be used. Detectors 160, 161, and 162 generate electrical signals that are representative of the intensity and polarization state of the scattered radiation. These electrical signals can be analyzed by means of a lock-in amplifier that is tuned to the modulation frequency of the polarization modulator or harmonics of that modulation frequency. Alternatively, the electrical signals produced by the detectors 160, 161, and 162 can be digitized and analyzed by means of a digital filter, such as a Fourier Transform.

Detailed Description Text (104):
Returning again to FIG. 3, the present invention provides a means for performing Raman and emission measurements as follows. Light from a light source 115,

preferably a laser, is collimated by lens 119 and reflected by a dichroic beamsplitter 124. The reflected light is focused by lens 126 and impinges on the finger 117. At least one of Raman scattering, fluorescence, or phosphorescence is collected and collimated by lens 126 and focused by lens 127 onto a wavelength selective element 121. Lens 127 is preferably optimized to concentrate the incident light beam onto detector 107 and to match the geometrical characteristics of the collected light to the size and acceptance angle of the wavelength-selective element 121 and the detector 122. In a preferred embodiment, a Rayleigh rejection filter 152 is inserted in the optical path between lens 127 and wavelength-selective element 121. Rayleigh rejection filter 152 may comprise, for example, a holographic filter, a dispersive element combined with a spatial filter, a dielectric filter, an electronically tunable filter such as an acousto-optic tunable filter (AOTF) or a liquid-crystal tunable filter (LCTF), or any other filter having suitable Rayleigh rejection characteristics. In a preferred embodiment, Rayleigh rejection filter 152 comprises a holographic filter.

Detailed Description Text (105):
Wavelength-selective element 121 allows certain wavelengths of light to be transmitted to the detector 122 by means of either a dispersive or interferometric selection mechanism. Wavelength selective elements, such as a Czerny-Turner monochromator, can be used in a scanning mode with a point detector or, preferably, the wavelength selective element is coupled to an array detector. A typical array detector may be a silicon photodiode array or, in a preferred embodiment, the array detector may be a charge coupled device (CCD) or Charge Injection Device (CID) detector. InGaAs detectors are optimized for the NIR and can be operated at room temperature or cooled to liquid nitrogen temperatures.

Detailed Description Text (115):
As shown in FIG. 6, a single detector 114 measures the intensity of the scattered radiation as a function of the incident polarization state. Detector 114 may comprise a point detector or an imaging detector, such as a CCD, a CID. In a preferred embodiment, detector 114 is a point detector. A point detector, such as a photodiode, has a faster response time than the CCD and, therefore, is more amenable to high frequency modulation and detection schemes. In an alternative embodiment, the scattered light is measured using an imaging detector, such as a CCD or a CID. An imaging detector has the capability of recording the scattered intensity as a function of one or more spatial dimensions along the skin surface.

Detailed Description Text (117):
In a preferred embodiment, polarization state analyzer 123 is a simple thin film polarizer, such as a stretched polymeric film, positioned in front of the detector 108. The polarizer may be either a linear polarizer or a circular polarizer. In a particularly preferred configuration, depolarization is measured by modulating the incident polarization state as shown in FIG. 4, and analyzing the scattered light with a fixed polarizer.

Detailed Description Text (118):
Although a finger is shown in FIG. 6, it should be understood that other body parts, such as an earlobe, may be preferably used for depolarization measurements in order to increase the sensitivity of the measurement. For example, the internal structures (bones, cartilage, tendons) of the finger will almost completely depolarize the light which is incident on the finger. The polarization state of light passing through the earlobe, however, is preserved to a greater degree due to the lower amount of internal structure in the earlobe relative to the finger.

Detailed Description Text (123):
The apparatus of FIG. 8 comprises a multispectral imaging system that uses multiple spectral dimensions (i.e. IR, Raman, Fluorescence, etc.) and one or more spatial dimensions. Additionally, a series of measurements may be performed over time, thereby adding a temporal dimension.

Detailed Description Text (125):
image field and is achromatic.

Detailed Description Text (126):
The system shown in FIG. 8 exhibits several advantage. First, multiple spectroscopic images may be recorded. The system shown in FIG. 8 might, for example, be used to measure a temporal oscillation in one or more parameters of the sample.

Detailed Description Text (127):
By using imaging detectors and image analysis techniques, such as a multidimensional Fourier transform, the signals that are contained in particular spatial frequencies across an image plane of the tissue sample may be selected. For example, a spectroscopic image of a tissue sample will contain blood vessels of regular sizes and such structures will contribute particular spatial frequencies to the image. Spectroscopic information may be obtained from these structures by collecting a spectroscopic image (i.e., an image at multiple wavelengths) and performing a multidimensional Fourier transform on the spectroscopic image. Other image processing techniques, such as segmentation, may also be employed.

Detailed Description Text (130):
An exploded view of another embodiment of the present invention is provided in FIG. 9. Device 201 is a hand-held, noninvasive multiplex sensor that may be used for measuring at least one parameter (e.g. the concentration of an analyte such as glucose), in a sample, (e.g. a body part). An activating button 202 is depressed by the user to activate the instrument prior to use. Optical head 203 contains an array of light sources and detectors and an optical window 204, which is transparent to the light that is emitted or detected by device 201. Appropriate light sources may be, for example, infrared emitting diodes (IREDs) or laser diodes. Photodetectors 207, which are also provided inside the optical head, measure the light that is backscattered by the sample. Preferred photodetectors may be, for example, a photodiode, a charge coupled device, or a charge injection device. Any other suitable detector may be used. The detectors are preferably optimized for a given wavelength range and may consist of, for example, silicon, InGaAs, Ge, or PbS detectors. Photodetectors 207 are attached to a preamplifier board 208, which contains electronic circuitry in accordance with its function. Batteries 206 provide power for the device. Optical window 204 could also be designed to filter out stray ambient light, thereby further reducing noise in the measurement.

Detailed Description Text (131):
Several preselected wavelengths of infrared radiation are focused onto the sample. Radiation that is reflected, emitted or scattered by the sample is collected by detectors 207. Quantitative analysis is performed by the central processing unit 215 in conjunction with a multivariate calibration model and algorithms stored in module 217. A concentration value is subsequently displayed by a display unit 212, which is connected to the central processing unit 215. Display unit 212 is preferably a liquid crystal display, which is large enough to be easily read by patients with visual dysfunction, such as that caused by advanced stage diabetes. Alternatively, an audible readout may be provided.

Detailed Description Text (133):
One embodiment of the present invention provides a method of measuring in-vivo glucose concentrations that combines measurements of infrared absorbance (in both forward and backscattering geometries) with diattenuation measurements. The results of these measurements are shown in Table 3 below.

Detailed Description Text (136):
Another embodiment of the present invention provides a method of measuring blood

glucose that is corrected for spectral variables (such as water (tissue hydration), hemoglobin, tissue scattering (refractive index), and temperature) by means of a combination of complementary spectroscopic techniques. Specifically, glucose measurements are performed using a combination of infrared absorbance, photoacoustics, and scattering measurements.

Detailed Description Text (139):
A sample is illuminated with infrared light and the infrared absorbance is measured as a function of the wavelength of light absorbed. A plot of the infrared absorbance versus wavelength is referred to as an infrared absorbance spectrum and has an associated spectral dimension, namely, the wavelength of the light absorbed by the sample. Within the same embodiment, at least one additional complementary spectroscopic technique is applied, (e.g. Raman scattering, photoacoustics, polarimetry, fluorescence spectroscopy, etc.), thereby adding at least one more spectral dimension to the measurement.

Detailed Description Text (140):
Further, and within the same embodiment, at least two spectral dimensions are recorded as a function of at least one spatial dimension of the sample. In the present example, a spatial dimension of the sample may be measured using an imaging detector, such as a charge-coupled device (CCD) detector, or by multiple discrete detectors. Further, and still within the same embodiment, the measurements described above are performed over time in order to measure a temporal dimension. The concentration of the at least two sample constituents are thus measured as a function of at least two spectral dimensions, at least one spatial dimension, and at least one temporal dimension.

Detailed Description Paragraph Table (1):
TABLE 3 _____ Wavelength Measurement (nm) % CV _____ 1. IR, Forward Scattering 1000 nm 26.1 2. IR, Forward Scattering 1150 nm 25.9 3. IR, Backscattering 1400 nm 23.8 4. IR, Backscattering 1650 nm 23.1 5. DC scatter 633 nm 26.2 6. Circular diattenuation 633 nm 25.6 7. 1-4 combined 17.2 8. 1-6 combined 16.5

CLAIMS:

1. A method for measuring at least one parameter of a sample comprising the steps of:

(a) illuminating said sample with light;

(b) performing at least two spectroscopic measurements, wherein said at least two spectroscopic measurements are different members of the group consisting of:

infrared absorbance,

scattering,

diattenuation,

emission spectroscopy,

photoacoustic spectroscopy,

provided that said photoacoustic spectroscopy relates acoustic signal intensity directly to the measurement of said at least one parameter of said sample; and

(c) analyzing said spectroscopic measurements to determine a measurement of said at least one parameter of said sample.

10. The method of claim 9, wherein said physiological variable is selected from the group consisting of:

(i) temperature,

(ii) pulsatile flow,

(iii) tissue scattering, and

(iv) sample heterogeneity.

12. A method for measuring at least one parameter of a sample comprising the steps of:

(a) illuminating said sample with light;

(b) performing at least two spectroscopic measurements, wherein said at least two spectroscopic measurements are different members of the group consisting of:

infrared absorbance,

scattering,

polarimetry,

emission spectroscopy,

photoacoustic spectroscopy,

provided that said photoacoustic spectroscopy relates acoustic signal intensity directly to the measurement of said at least one parameter of said sample; and

(c) analyzing said spectroscopic measurements to determine a measurement of said at least one parameter of said sample, further comprising the step of measuring at least one spatial dimension.

13. A method for measuring at least one parameter of a sample comprising the steps of:

(a) illuminating said sample with light;

(b) performing at least two spectroscopic measurements, wherein said at least two spectroscopic measurements are different members of the group consisting of:

infrared absorbance,

scattering,

polarimetry,

emission spectroscopy,

photoacoustic spectroscopy,

provided that said photoacoustic spectroscopy relates acoustic signal intensity directly to the measurement of said at least one parameter of said sample; and

(c) analyzing said spectroscopic measurements to determine a measurement of said at least one parameter of said sample, further comprising the step of measuring at

least one temporal dimension.

14. A method for measuring at least one parameter of a sample comprising the steps of:

(a) illuminating said sample with light;

(b) performing at least two spectroscopic measurements, wherein said at least two spectroscopic measurements are different members of the group consisting of:

infrared absorbance,

scattering,

polarimetry,

emission spectroscopy,

photoacoustic spectroscopy,

provided that said photoacoustic spectroscopy relates acoustic signal intensity directly to the measurement of said at least one parameter of said sample; and

(c) analyzing said spectroscopic measurements to determine a measurement of said at least one parameter of said sample, further comprising the step of measuring at least one spatial dimension and at least one temporal dimension.

15. A method for measuring at least one parameter of a sample comprising the steps of:

(a) illuminating said sample with light;

(b) performing at least two spectroscopic measurements, wherein said at least two spectroscopic measurements are different members of the group consisting of:

infrared absorbance,

scattering,

polarimetry,

emission spectroscopy,

photoacoustic spectroscopy,

provided that said photoacoustic spectroscopy relates acoustic signal intensity directly to the measurement of said at least one parameter of said sample; and

(c) analyzing said spectroscopic measurements to determine a measurement of said at least one parameter of said sample, further comprising the step of removing an interference related to at least one spectral variable.